

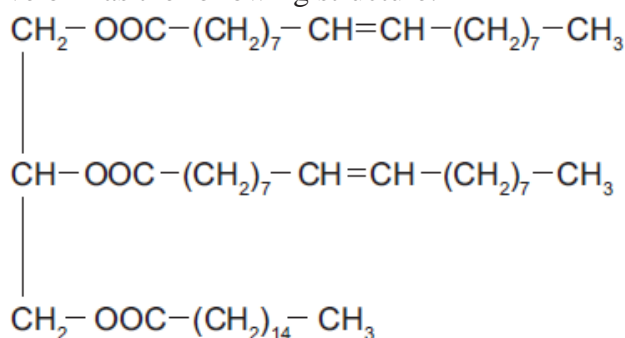
Esters and Triglycerides

1) Discuss the similarities and differences in the reactions of methyl propanoate, $\text{CH}_3\text{CH}_2\text{COOCH}_3$, in basic conditions with NaOH , and in acidic conditions with HCl .

In your answer you must:

- describe the type of reaction
- write equations showing structural formulae for reactions occurring.

2) A triglyceride found in olive oil has the following structure:



i) Put a **circle** around one of the ester groups in the triglyceride molecule shown above.

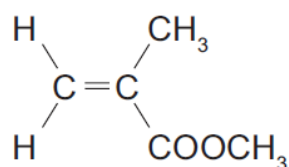
ii) This triglyceride is described as being an unsaturated molecule, which means that it contains carbon to-carbon bonds, which are not single bonds.

Bromine water can be used to confirm that this triglyceride is unsaturated.

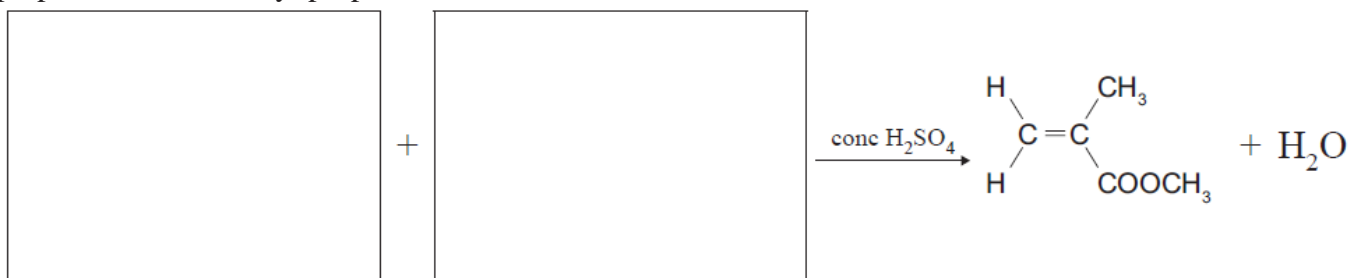
Describe the observations when bromine water is reacted with this triglyceride.

iii) Draw the structural formulae of the products produced by the hydrolysis of this triglyceride in basic conditions, using aqueous sodium hydroxide, NaOH .

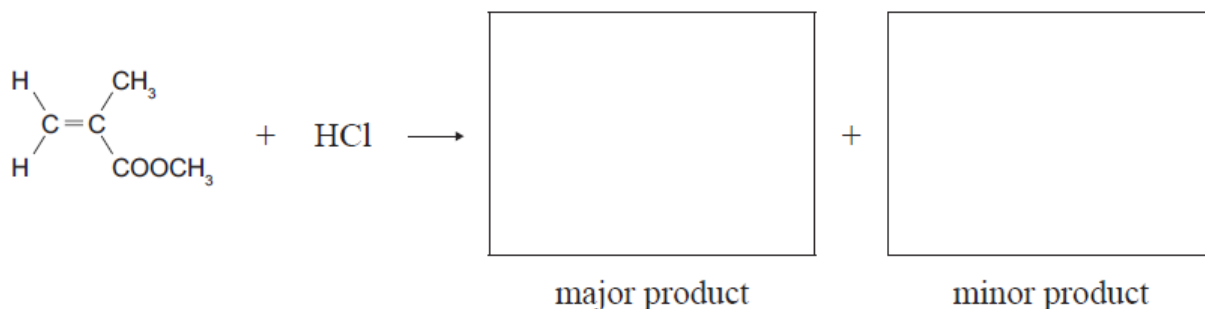
3) i) For the molecule below, **circle** the ester functional group and put a **square** around the alkene functional group.



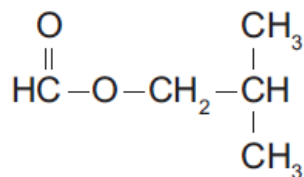
ii) Complete the equation below to show the **structural formulae** of the two organic reactants used in the preparation of 2-methyl propenoate.



iii) 2-methyl propenoate will react with HCl to give two different haloalkane products. Draw the **structural formulae** of the haloalkane products.



4) Esters are often responsible for the flavouring of fruit. The compound below is an ester with a raspberry flavour.



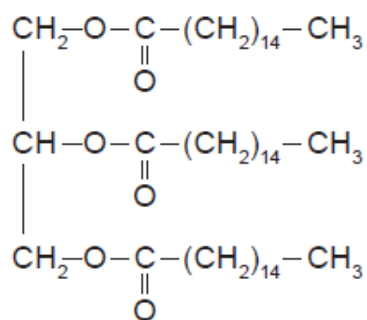
Esters can be prepared by *refluxing* the reactants with a small amount of **concentrated sulfuric acid**. After refluxing, the reaction mixture is treated with **potassium carbonate** and *distilled*.

Discuss the preparation of the ester shown above.

Your answer should include:

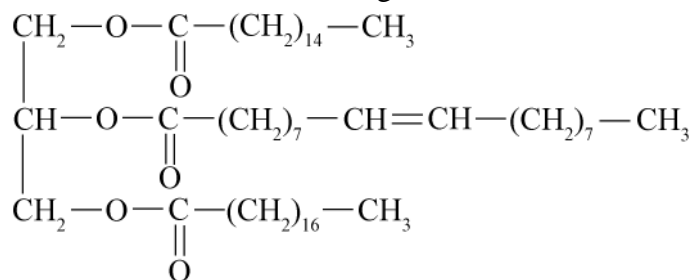
- an appropriate chemical equation for the formation of the ester
- the reason for using the chemicals stated in bold above
- a discussion of why reflux and distillation are used in this preparation.

5) The triglyceride shown below was heated with aqueous sodium hydroxide, NaOH.

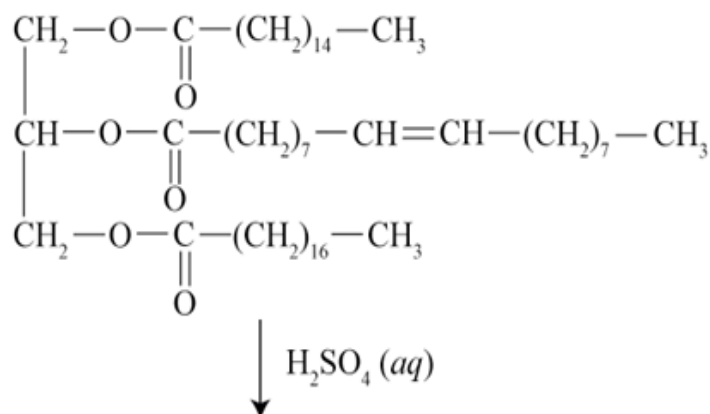


Draw the structural formulae of the two products formed in this reaction.

6) A triglyceride found in cocoa butter has the following structure.



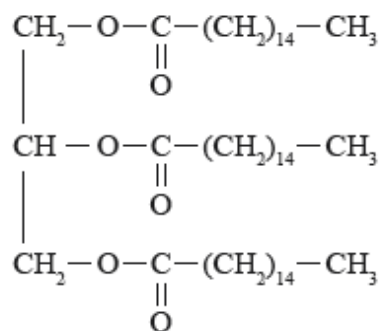
a) Complete the equation below, which shows hydrolysis of this triglyceride in acidic conditions using H_2SO_4 solution.



b)

Compare the products that would form if the hydrolysis occurred in basic conditions using NaOH solution.

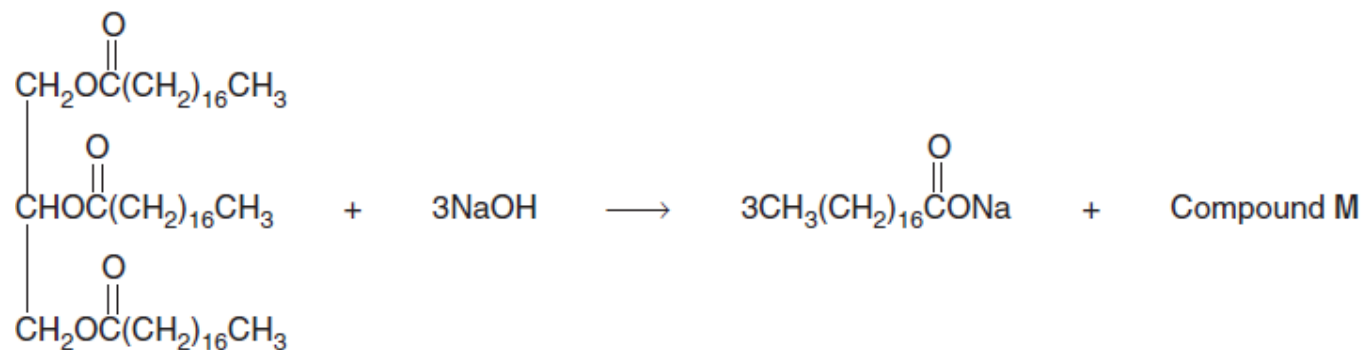
7) Palm oil contains the triglyceride with the structure shown below. It forms when glycerol (an alcohol) and palmitic acid (a carboxylic acid) react together.



a) Use the diagram above to deduce the structural formulae of glycerol and palmitic acid. Draw them.

b) The triglyceride shown above can undergo hydrolysis in **acidic** or **basic** conditions. How will the different hydrolysis conditions affect the products of the reaction?

8) Fats and oils are **triesters** molecules. Hydrolysis of a fat can be represented by the equation below.



a) Circle ONE of the ester groups in the fat.

b) Write the name of the functional group that would be present in compound M.

Unsaturated fats are usually considered to be healthier than saturated fats.

c) What is meant by the term **unsaturated**?

d) Describe a test, using a solution of bromine in a non-polar solvent, that could be carried out in the laboratory to compare the degree of unsaturation of two fats.